snapAG PLANT BIOTECHNOLOGY

WHAT ARE GMOs?

WHAT'S in a name?

GMO stands for “genetically modified organism”. The genetics of virtually all plant-based food we eat today have been modified over time, so the term “GMO” could technically apply to all of them. When people talk about GMOs, they are often referring to **genetic engineering.**

Genetic engineering refers to specific methods used to precisely change an organism’s DNA. This method of plant breeding is used by scientists to enhance or modify the characteristics of an individual organism

*Plant domestication by the earliest farmers 10,000 years ago is an example of **genetic modification**. There are many ways to genetically modify a plant. These include domestication, conventional breeding, mutagenesis and genetic engineering.*

TYPES of Genetic Engineering

A **transgenic** plant is one that contains a gene or genes which have been introduced artificially into the plant's genetic makeup using a set of several biotechnology techniques collectively known as recombinant DNA (rDNA) technology.

Cisgenics involves only genes from the same species or a cross-compatible species, a process that could otherwise happen—though over a considerably longer period of time—through breeding or other natural methods.

Cisgenics and transgenics can use the same genetic engineering techniques the only difference being the source of the genetic material.

The Artic Apple® used a cisgencic technique called RNA interference or gene silencing to “turn off” the genes that make apples turn brown.

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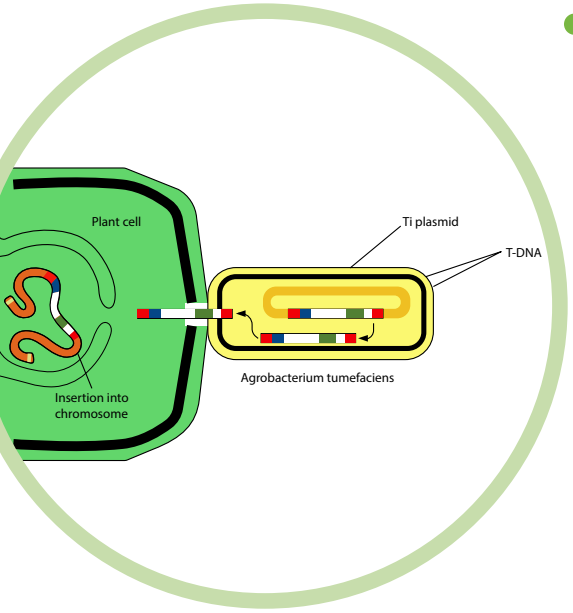
USING NATURE TO ADVANCE SCIENCE

Early in the 1900s, scientists discovered a soil bacterium, *Agrobacterium tumefaciens* that could naturally transform plants. It is an unusual pathogen because when it infects a host, it transfers a portion of its own DNA into the plant cell, changing the plant's cellular growth.

One of the most important characteristics of *A. tumefaciens* is that the bacterium is specific to plants, making it completely safe for animals and people. The bacterium was studied extensively, and scientists recognized that its natural DNA insertion machinery could be used as a tool to insert DNA into plant parts.



THE PROCESS

Scientists locate the desired genes or genes containing the information for the desired trait. Once located, the information is copied thousands of times, in a process called **gene amplification**. Once amplified, these genes, can be joined with the *A. tumefaciens* machinery, and once together the bacterium's insertion machinery is used as a tool to insert the desired trait into the plants.

An alternative to *A. tumefaciens* is the use of biolistics, which involves the coating of small particles with the DNA of the desired trait. Once coated the small particles are delivered at a high speed into the cells. Once inside the cell, the DNA falls off the particles and becomes a part of the host genome.

Gene silencing is often used in cisgenics. This is when the regulation of gene expressions is prevented leading to an inactivation of previously active genes.

TRY, TRY AGAIN

While genetic engineering can introduce which genes you want, it doesn't necessarily put them where you want. Inserted genes might end up interfering with genes required for the plant to grow and reproduce. They might end up in spot where they don't work very well – or do nothing at all. It can take many tries to get a favourable result.

Once researchers confirm the genes have been taken up and are doing what they're supposed to, the next step is to grow the plant. This is to make sure the new genetic traits are active and stable over generations. Once this rigorous testing is complete, the new variety can be registered with government agencies. It typically takes over 13 years for a new trait to go from an idea to the field.

Genetic Engineering is complex and involves many steps and vigorous testing before a plant with a novel trait is released on the market.

The **genetically modified crops available today are:** alfalfa, apples, canola, corn (field and sweet), cotton, papaya, potatoes, soybeans, squash, eggplants and sugar beets. The efforts to genetically modify these crops focus on expressing positive traits that support quality of the crop and improving resistance to certain concerns, such as insects.